Unit-II

Variability, Mean Deviation, Standard deviation

Normal Probability Curve

Variability

- How spread out the scores are.
- Opposite of Variability is consistency
- Large difference among score-the data is said to contain a lot of variability.

Mean Deviation

In statistics, deviation means the difference between the observed value and the expected value of a variable. In simple words, the deviation is the distance from the centre point. The centre point can be median, mean, or mode. Similarly, the mean deviation or the mean absolute deviation is used to compute how far the values fall from the middle of the data set.

Mean deviation can be described as a statistical measure that is used to compute the average deviation from the average value of the given data set.

To Calculate Mean Deviation-

Step 1: Find the mean or the average value for the given data values.
Step 2: Then, find the difference of the mean value from each of the data values given ignoring the signs.
Step 3: Now, find the mean or average of those values obtained in step. The result obtained in step 3 is the mean deviation.

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If we take the ages of the students listed above, we find that the total of the ages is -

18 + 21 + 23 + 18 + 19 + 19 + 19 + 33 + 18 + 19 + 19 + 20 = 246.

Divide this total by 12 and we get the average age in the set to be 20.5 years.

Now if we subtract 20.5 years from each of the student's ages

Score	Deviation from mean	$(X\text{-mean})^2$
18	-2.5	6.25
21	.5	.25
23	2.5	6.25
18	-2.5	6.25
19	-1.5	2.25
19	-1.5	2.25
19	-1.5	2.25
33	12.5	156.25
18	-2.5	6.25
19	-1.5	2.25
19	-1.5	2.25
20	-.5	.25
Mean=20.5		193

Variable	**N**	**Mean**	**Variance**	**Range**
Age	12	20.5	16.08	15

Standard Deviation

The standard deviation is like the mean, in that it takes all of the values in the dataset into account when it is calculated, and it is also like the mean in that it needs to make some assumptions about the shape of the distribution. To calculate the standard deviation, we must assume that we have a normal distribution.

Conceptually standard deviation is distance along a frequency distribution of scores

Standard deviation computationally is the square root of variance

The standard deviation of a set of scores is measured relative to all of the scores in that set. Put as simply as possible, the standard deviation is the 'average' amount by which scores differ from the mean or average score. Now this is an odd idea – basing your standard measure on a set of scores rather than on an absolute standard. Nevertheless, it is an important concept to grasp.

Although the standard deviation is an average, it is not the sort of average which most of us are used to. However, it is of greater use in statistical applications than any other way of calculating the average deviation from the mean.

The standard deviation is important in statistics for many reasons. The most import ant is that the size of the standard deviation is an indicator of how much variability there is in the scores for a particular variable. The bigger the standard deviation the more spread there is in the scores. However, this is merely to use standard deviation as a substitute for its close relative variance.

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Standard Deviation Formula	
Population	**Sample**
$\sigma = \sqrt{\frac{\sum(X-\mu)^2}{N}}$	$s = \sqrt{\frac{\sum(X-\bar{x})^2}{n-1}}$
X – The Value in the data distribution *μ – The population Mean* *N – Total Number of Observations*	*X – The Value in the data distribution* *$\bar{x}$ – The Sample Mean* *n - Total Number of Observations*

Example –9, 8, 7, 1, 11, 10, 4, 13, 4, 3, 7

Scores	X-X(mean)	$(X-X)^2$
9	2	4
8	1	1
7	0	0
1	-6	36
11	4	16
10	3	9
4	-3	9
13	6	36
4	-3	9
3	-4	16
7	0	0
Mean= 7		136

$$s = \sqrt{\frac{\sum (X-\bar{x})^2}{n-1}}$$

$$s = \sqrt{\frac{(136)}{11-1}} = \sqrt{\frac{136}{10}} \quad \sqrt{13.6} \quad 3.69$$

Z score

Why do we need z score?

- For hypothesis testing and interpreting Means
- calculate the probability of a score occurring within a standard normal distribution;
- and enables us to compare two scores that are from different samples (which may have different means and standard deviations).

Two parts of the z score

- Signs (+, -)
- Numbers- Tells us the distance between the score and mean in terms of standard deviation.

once the size of the standard deviation is known, all scores can be re-expressed in terms of the number of standard deviations they are from the mean. One big advantage of this is that, unlike other standard units of measurement such as distance and weight, the number of standard deviations will apply no matter what the variable being measured is. Thus, it is equally applicable if we are measuring time, anxiety, depression, height or any other variable. So, the number of standard deviations is a universal scale of measurement. But note the stress on the number of standard deviations

Example-To convert the age of a 32-year-old to a z-score, given that the mean of the set of ages is 40 years and the standard deviation of age is 6 years, just apply the following formula:

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$$Z = \frac{raw\ score - mean}{standard\ deviation}$$

$$Z = \frac{X-\mu}{\sigma}$$

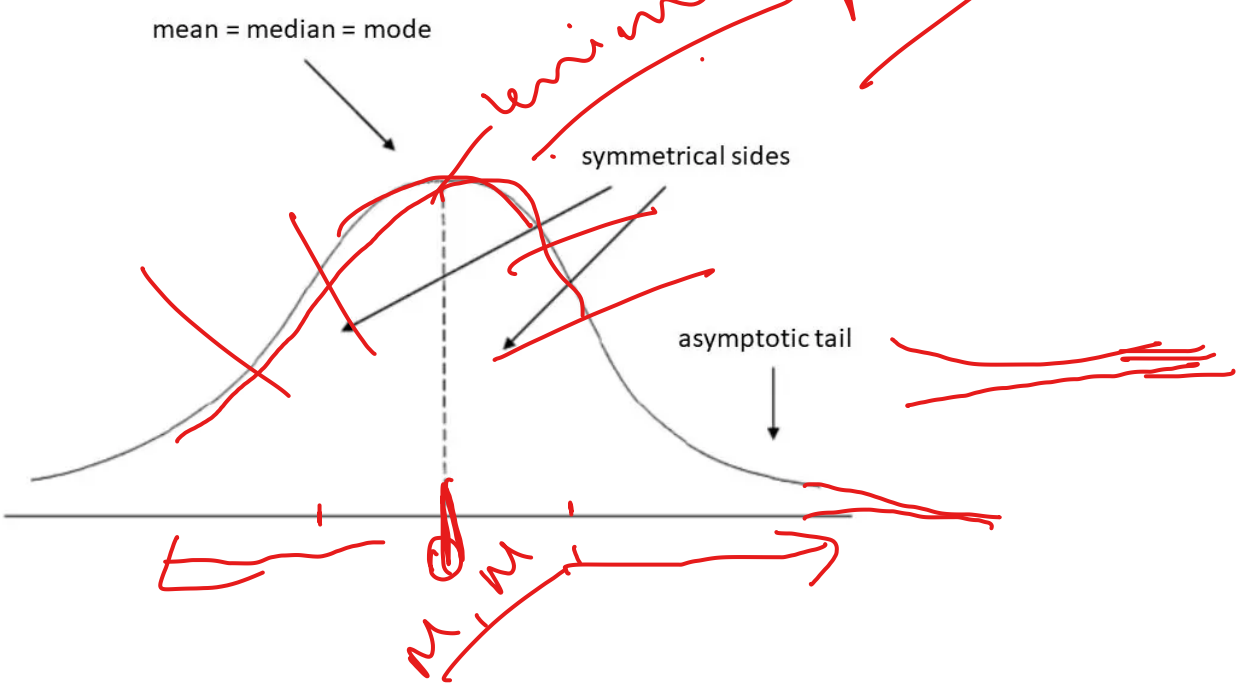
Where

X is the raw score
μ is the mean
σ is the standard deviation

z score = -1.33

Normal Probability Curve

The normal curve describes a particular shape of the frequency curve. Although this shape is defined by a formula and can be described mathematically, for most purposes it is sufficient to regard it as a symmetrical bell shape



Characteristics of Normal Probability Curve

- The normal curve is symmetrical
- The normal curve is unimodal
- Mean, median and mode coincide
- The maximum ordinate occurs at the centre
- The normal curve is asymptotic to the X-axis
- The height of the curve declines symmetrically.
- The normal curve is bilateral
- The total percentage of area of the normal curve within two points of influxation is fixed:
- Approximately 68.26% area of the curve falls within the limits of ±1 standard deviation unit from the mean as shown in figure below.

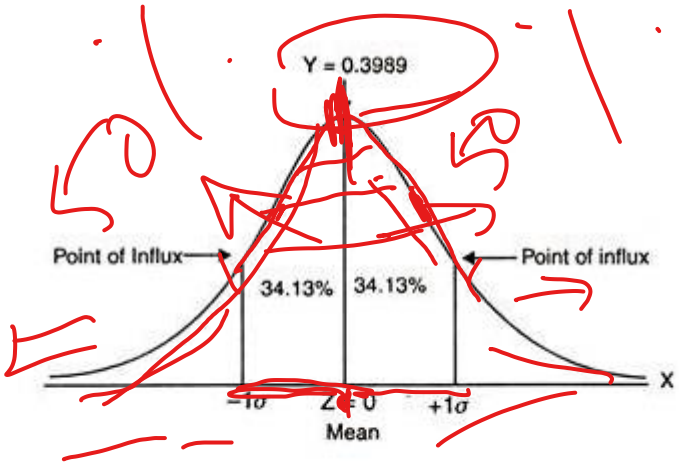
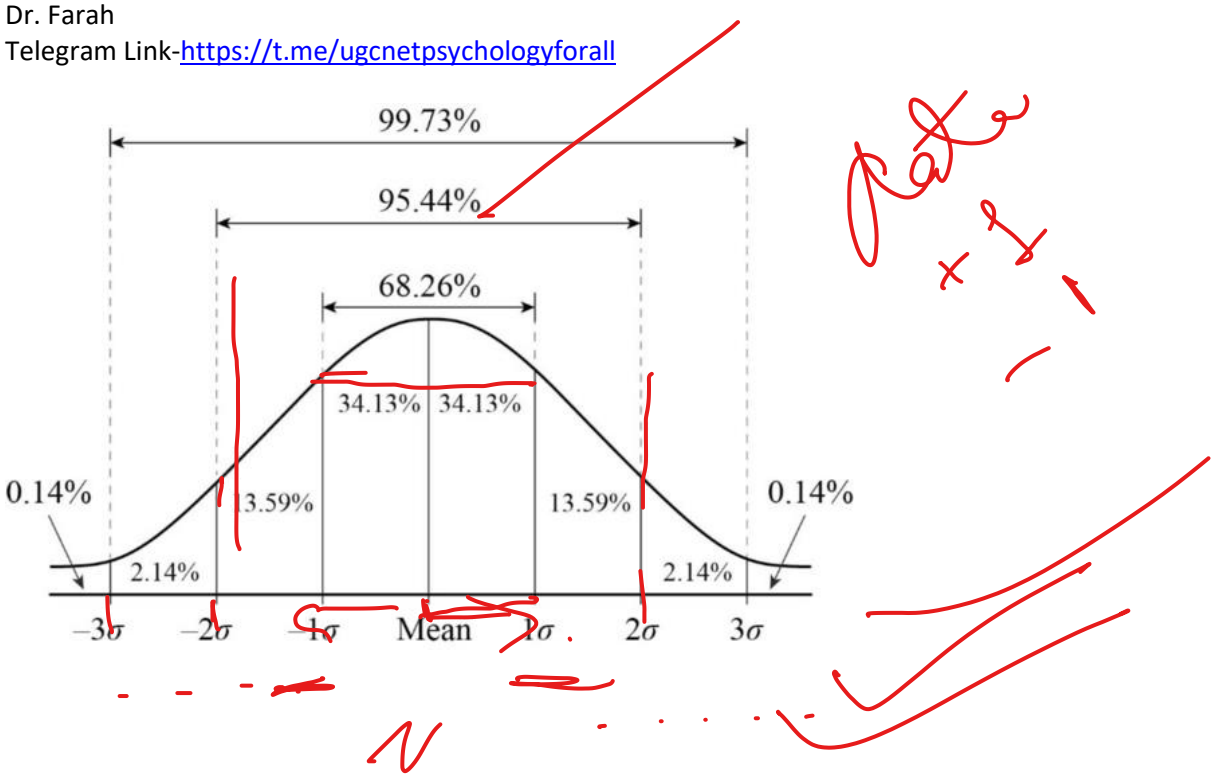


Fig. 6.5 N.P.C., 68.26% area of the curve within the limits of ±1σ



Note- A normal distribution is determined by two parameters the mean and the variance. A normal distribution with a mean of 0 and a standard deviation of 1 is called a standard normal distribution.

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